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ANNALES MYCOLOGICI, VOL. II. NO. 1, JAN. 1904, CONTAINS the following articles: Copeland, New and Interesting California Fungi; Petri, *Naucoria nana* sp. n.; Saccardo, Notae Mycologicae; Dietel, Ueber die Uredineengattung *Pucciniostele* Transchel et Komarov; Sydow, Neue und kritische Uredineen; Rehm, *Ascomycetes Americae borealis*; Höhnelt, Mycologische Fragmente, Fortsetzung; Vuillemin, *Le Spinellus chalybeus* (Dozy et Molkenboer) Vuillemin et la Série des Spinellées; Salmon, Cultural Experiments with the Barley Mildew, *Erysiphe Graminis* DC.

ASCOMYCETES AMERICAЕ BOREALIS, AUTORE DR. H. REHM, Ann. Mycolog. 2:32-7, Jan. 1904, includes notes and descriptions of 16 species of Discomycetes, nearly all of which are new and interesting, collected by Lloyd, Durand, and Harper.

NEUE UND KRITISCHE UREDINEEN, II, VON H. U. P. SYDOW, Ann. Mycolog. 2:27-31, Jan. 1904, includes five new North American species belonging to the genera *Gymnosporangium*, *Phragmidium*, *Uredinopsis* and *Uredo*. A *Gymnosporangium* occurring on *Libocedrus decurrens*, California, was referred to (not described) by H. Mayr in "Die Waldungen von Nord Amerika" (1890) as "*G. libocedri*"—then (in 1898) referred to *Phragmidium libocedri* P. Henn. n.sp. by the latter mycologist. But the specimens destroyed by insects, spores not examined, etc., the Messrs. H. & P. Sydow think "so ist *G. libocedri* am besten ganz zu streichen." Their species, *G. aurantiacum*, occurs on the leaves of the host named—but Mayr's bildet Anschwellungen an den älteren Zweigtheilen. Sydow's species and Hennings' *Phragmidium* may be the same thing, according to the former authors.

ELEMENTARY MYCOLOGY.

W. A. KELLERMAN.

It is intended to furnish a series of paragraphs for those who may wish to take up the general study of Fungi. It will be a brief as well as elementary treatment of the subject, calling attention first to the great number and varied character of the plants included in this group, their general structure and mode of life, and then giving an outline of the groups with such illustrations as may seem desirable for the needs of beginners.

MYCOLOGY. — This term is formed from two Greek words, *my-cēs* meaning mushroom or fungus, and *logos*. The real or original meaning of the first Greek word is *slime* or *mucus* — and of course was used to designate these plants — or the peculiar material which in the early days was not really understood and not at all supposed to be closely allied in fundamental structure and mode of life to our common plants. Some of the plants

belonging to this group are really *slime-like* or of the consistency of thin jelly in their early stage; they are called the "Slime Moulds." But they are not often observed except by botanists, being mostly minute in size, living in retired places, as shady woods, etc.,—rotten logs being a favorite habitat of many of the species. Many of the common Mushrooms also are fleshy, that is, of soft consistency—and it is therefore readily understood why the term *Mycology* was formed to indicate the division of Botany which has to do with the group of plants under consideration.

FUNGI.—A suggestion regarding the word itself may be timely. Simple as it is, the term is not always spoken correctly. *Fun'-gus* is to be pronounced like "bo'-gus," with the *g* hard; but the plural, *fun'-gi*, has the *g* soft, and therefore is pronounced "fun-ji"—the accent being on the first syllable, and the *i* in the last syllable long, hence should be pronounced like "eye". The plants constituting this group are numerous and exceedingly varied in outward structure. Those known to all, are the Mushrooms, Toadstools, Morels, Puffballs, Truffles, Rusts, Smuts, Black Knot of Plum and Cherry trees, the "Cedar Apples," Moulds, and Mildews. The Bacteria are usually included in the group of Fun'-gi; they are plants of simple structure and exceeding minuteness, but the work they do as agents of fermentation and decay of organic matter, souring milk and curing cheese, disintegrating even mineral and vegetable matter in soils, and as agents of many of the diseases of man and the lower animals, is everywhere witnessed. The various kinds of rots and decays of fruits and vegetables are induced by species of fungi. The common diseases of fruit trees, such as the Peach 'leaf-curl,' Plum 'pockets,' Anthracnose of Raspberries, Grapes, etc., as well as the Ergot of Rye, the Club-root of Turnip and Cabbage, Crown-gall of some of the fruit trees, and 'witches-brooms,' are abnormal growths, or injured tissue due solely to the attacks of various kinds, mostly microscopic fungi. The Yeast plant is another fungus—its simple structure and minute size being in inverse proportion to its usefulness—having been cultivated from time immemorial and like other domesticated plants as Maize, Wheat, Olives, etc., not known in the wild state. The existence of still another large group of parasitic fungi is witnessed by the "Leaf spots," or little areas of dead tissue in living leaves of many herbs, shrubs, and trees during the growing season. A leaf may be so severely attacked as to succumb entirely—large irregular areas of dead tissue soon manifest, then the entire leaf turning yellow and dying; the young twigs also are sometimes involved. The fungi themselves are invisible—the destructive work only revealing their presence; a microscope is necessary for their detection.

VEGETABLE LIFE. — An epitome of the known processes of life and growth of our common plants, and their minute structure may serve as a basis for brief explanation of the structure and mode of life of the Fungi. The herbs, shrubs and trees develop roots in the soil which terminate in minute fibrils that push out between the finer particles of which the soil is composed. These tiny rootlets have near their tips, during the growing season, an abundance of slender tube-like outgrowths, called *root-hairs*. These delicate elongated *cells*, as such structures are called, apply themselves closely to the soil particles and absorb the thin layer of adhering moisture. This moisture or water has passed previously through the atmosphere—falling as rain or water on the surface, then slowly percolating through the soil, dissolving very small quantities of triturated rock (for that is what soil mainly consists of) and some of the partially decomposed organic matter that may also be present. Water is not a good solvent for granite and marble, nor even for the softer limestone, but its disintegrating power is greatly increased by the carbon dioxide and traces of other gases it absorbs in passing through the air, but especially by the larger quantity of these substances, together with various alkalis which it takes up in percolating through the soil. It therefore happens that ample food materials for our common plants is held in dilute solution in this thin layer of moisture which the root-hairs seek and abstract from the soil particles. The root-hairs—like all other ordinary living vegetable cells—consist of an active, more or less granular but nearly transparent substance, in consistency somewhat like thin jelly, detected but little over half a century ago and given the name of *pro-to-plasm*. It is this—the physical basis of ‘life’ as interpreted to-day—which does the work of absorption—pulling the water-particles away from the attracting soil particles and appropriating the booty for its own use. The cell ‘wall,’ or tube (covering) referred to above, is permeable to liquids allowing the water to pass readily. Whether this absorptive power of the protoplasm is referable simply to the physical process called ‘osmosis’ need not concern us here—it is exhibited at any rate only in the *living* protoplasm. The roots, stems and leaves are made up exclusively of cells—that is, tiny masses of protoplasm with a delicate covering or wall (the material of which is cellulose) which are joined to one another to make the firm plant body. Moreover the cells have taken on various shapes, round, angular, elongated, etc., and some of the walls become much thickened, often hard, and thus the plant body is complex in structure—though in the very early stages of its development it was comparatively simple. Now, the water, which contains the food-material in solution, passes from cell to cell—through the walls and through the protoplasm, reaching

finally the leaves and other green parts of the plant. Here in the presence of sunlight, the material is decomposed by the protoplasm, new compounds are formed, and these further changed by processes, not yet fully understood, into products also not yet physically and chemically elucidated. But the digested material finally undergoes assimilation, or change into the vegetable fabric of the plant body.

RESPIRATION. — So important a life process as the consumption of oxygen deserves brief but special consideration. Taking carbon dioxide from the air and various other food materials from the soil, was outlined in the previous paragraph; the decomposition of these substances into simple elements and recombination into simple and complex compounds, which takes place in the protoplasm of the common plants, in those cells in which chlorophyll is present — the energy derived from the sun (i. e. light energy) appropriated for the performance of this important work, — have also been briefly mentioned. But this complicated work is done only when an ample supply of oxygen is at hand. If no air (oxygen) is present in the soil, the root-hairs and the rootlets are unable to perform the work of absorption. If the leaves are deprived of oxygen the protoplasm in their cells likewise ceases its activity. Not only common observation, but accurate experiments as well, indicate the necessity of oxygen to the performance of what we call the vital activities. It is true for all organisms — whether vegetable or animal, whether simple or complex in structure or form.

LIFE-OUTLINE OF A FUNGUS. — The fungi are simple in structure and destitute of green matter — a substance that will hereafter be referred to as *chlo'-ro-phyll* (the word itself meaning 'leaf-green'). They manifest simple life processes, though fundamentally these are the same in all organisms whether plants or animals, whether the structure is simple or complex. The most conspicuous distinction when contrasted with the common plants is their lack of chlorophyll; fungi may be hyaline, white, black, brown, yellow, or almost any other color, but never green, at least they are not green like common vegetation in which this universal coloration is due to the presence of chlorophyll in the cells. Evidently then their mode of life is very different; they can not manufacture their food material out of carbon dioxide, water, and other mineral substances. Consequently they must get their food — already prepared or partly digested — directly either from living plants or animals, or from the organic matter in which the life-processes have ceased to manifest themselves, the so-called dead matter. If they take their food from living organisms we say they are *parasitic*, but if they affect dead matter (which they decompose to greater or less extent) we say they are *sap-ro-phyt-ic*. Whether they obtain food from living or-

ganisms or decaying matter the fungi may inhabit only the surface of the host or matrix; the absorption may be direct or suckers, usually very simple, may be developed that penetrate to some depth. They may however reside only in the interior of the host, or deep-seated in the nourishing substance. An example of the former is seen in the common Leaf Mildew a whitish or later dingy coating on leaves of the Lilac or of the Cherry; of the latter may be mentioned the bacteria that cause splenic fever or tuberculosis. Some fungi may live on the surface in part and concealed in tissue in part. The oxygen necessary for the activity of these organisms may be taken from the atmosphere or in case of some of the simpler fungi it is abstracted from the tissues or the mass of organic matter they occupy — necessarily disintegrating or decomposing the latter.

STRUCTURE OF FUNGI. — Special structures or organs of plants and other organisms have doubtless arisen in response to their needs; it is plain at any rate that the organs are in general adapted to the functions to be performed. The slender tubular root-hairs of the land plants are well fitted to absorb moisture from soil particles and the leaves by their expanded form and peculiar structure take carbon dioxide from the air, exhale moisture and collect the oxygen necessarily consumed in the liberation of energy requisite for the performance of various processes. Such forms and mechanical structures as trunk, stem, branches, and twigs, or leaf stems, are developed for the support of the leaves which must be hung out to the sun and bathed in the air. So important physiologically is this display of foliage that the modern botanists describe the leaf as a 'light-related organ' and refer its peculiar structure to the character of the work to be performed. The floral leaves — using this word to include all the organs of the flower — have very different and peculiar functions to perform, and they in turn are of such form and structure as suits the work to be done. Now, the Fungi gain their livelihood without chlorophyll — hence possess no leaves; having no leaves to support and display, they have need of no twigs, branches or stems. Resting on other plant bodies or growing within tissues their cell walls need not be lignified, need not be thickened nor of large dimensions. As a matter of fact the plants of this group are often extremely simple as well as very minute. Even when they are large, as for example a Mushroom, the cells of which they are composed are very simple and homogenous as compared with what is found in the varied and complex tissues of a vine or a tree.

ALGAE. — When contrasted with Algae (pronounced *al'-je* — the *g* having the sound of *j* in the word *jeer*), which are closely related in structure to the Fungi, the conspicuous difference is in the presence of chlorophyll in the former and its

absence in the latter. In botanical classification the Algae are generally placed lower than the Fungi, but while an Alga (here the *g* is hard as in the word *toga*), in case of some species, consists of a single small cell, some of these aquatic plants are very large and remarkably complex in external form and internal structure. As examples of the latter, may be cited the conspicuous Marine Algae, the so-called Sea-weed, Sea-moss, the Kelp, Sargassum, etc., as well as our common fresh-water Stoneworts, or Chara. The latter species consists of upright green plants, six to eighteen inches high, growing under water in clear shallow lakes or ponds, with their numerous regular branches in successive whorls, disposed at regular intervals on the stem. The species which form the Pondscums, or Green-felt in standing water, and the bluish-green, somewhat slimy coating on mud, or on the water's margin in muddy pools, are less complex than the Red or Brown Algae of salt water, or the ornamental Chara mentioned above. It is scarcely necessary to add that the Algae manufacture their own food out of inorganic materials — not being dependent on other organisms as the Fungi are, they are of course never parasitic. Aside from this physiological difference the two groups are remarkably alike and by many botanists are placed side by side — the lower Algae with the lower Fungi, and so on through the entire series — all together forming one of the large groups of the Vegetable Kingdom.

FUNGI DERIVED FROM ALGAE. — In the evolution of the vegetable kingdom it is reasonable to suppose that the simple Algae — possessing chlorophyll and being able to convert mineral matter into organic food and fabric — preceded those plants destitute of chlorophyll and which therefore could not live independently. Besides, thorough study in plant morphology and phylogeny (unfortunate words to use here but they will be elucidated later) has led botanists to the conclusion that the Fungi have actually descended from, i. e. really grown out of the simple Algae, — and it is believed also that from this same group of interesting plants, the Algae, our Higher plants have originated, even our Ferns and common Flowering plants! We can easily conceive that the simple Blue-green Algae living in stagnant pools where the water is highly charged with decaying or partially decomposed organic matter, may directly absorb some of this as a part of their food. Having then less need of the chlorophyll, some forms may have, in the course of a long series of generations, entirely lost this important green substance — when they would be called Fungi. Or if we imagine that a sudden change, a 'mutation,' took place, due to the 'rythmic' flow of life, or to the 'inherent' tendency to variation in successive progenies, yet we would think the evolution took place along the line suggested — namely, Alga to Fungus.

(To be continued.)